yet have derived its oil from them in the past. The oil has been largely moved away as formed. Hence, richly petroliferous shales are not a necessary indication in oil prospecting.

(*d*) Gravitational sorting requires not only a certain necessary degree of dip, but also a necessary degree of porosity, because in interstices below a certain size, surface tension checks the motion necessary for gravitational sorting. For this reason, water-filled shales or very fine-grained sandstones or limestones lying above porous rocks, act as impervious barriers, instead of allowing the oil and gas to reach the surface.

(*e*) While gas can move in a water-saturated rock with a lower degree of dip or with a lower porosity than oil, yet, since the gas bubble carries with it a pellicle of oil, a certain quantity of oil can be carried where it would not otherwise move.

(*f*) Inasmuch as all porous reservoirs in the strata constituting our oil fields were originally water-filled, dry porous sands really contain gas. It is not recognized because not under sufficient pressure to escape noticeably. This gas has been contributed to it generally by neighboring strata, and may have served for the transport of oil. As gas becomes more expensive, this gas may be extracted by suction, as is already done in gas-sands which have lost their pressure.

Of course, the principles here proposed are not exclusive of the action of gravitation and moving water, but act in conjunction therewith.

ROSWELL H. JOHNSON
BARTLESVILLE, OKLAHOMA

THE AMERICAN SOCIETY OF ZOOLOGISTS

THE Eastern and Central Branches of the American Society of Zoologists met in joint session at Princeton University, Princeton, N. J., December 27 and 29, 1911, in conjunction with the American Society of Naturalists and the American Association of Anatomists.

The following officers of the Eastern Branch for the ensuing year were elected:

President—A. G. Mayer, Carnegie Institution of Washington, D. C.

Vice-president—G. A. Drew, Marine Biological Laboratory, Woods Hole, Mass.

Secretary-treasurer—John H. Gerould, Dartmouth College, Hanover, N. H.

Additional Member of the Executive Committee—H. E. Jordan, University of Virginia.

These officers, in addition to David H. Tennent and Ross G. Harrison, will constitute the executive committee of the Eastern Branch. It is understood that the same officers of the Central Branch that served last year will continue in office.

The following persons were elected members of the American Society of Zoologists:

Central Branch—J. Frank Daniel, University of California; T. W. Galloway, James Milliken University; Wilhelmine Enteman Key, Lombard College; George R. La Rue, University of Michigan; Joseph A. Long, University of California; Marian L. Shorey, Milwaukee-Downer College; Aaron F. Shull, University of Michigan; Leroy D. Swingle, Nebraska Wesleyan University.

Eastern Branch—Thomas Barbour, Harvard University; M. T. Burrows, Cornell University Medical College; H. S. Colton, University of Pennsylvania; E. D. Congdon, Cornell University Medical College; Henry Fox, Ursinus College; Leland Griggs, Dartmouth College; Mary J. Hogue, Mt. Holyoke College; M. H. Jacobs, University of Pennsylvania; H. G. Kribs, University of Pennsylvania; C. V. Morrill, New York University and Bellevue Hospital Medical College; H. D. Reed, Cornell University; A. H. Wright, Cornell University.

The following committee was appointed to consider during the ensuing year the problem of the organization of the society, and to prepare a new constitution: H. V. Wilson, chairman; E. G. Conklin, G. A. Drew and R. G. Harrison (Eastern Branch); F. R. Lillie, W. A. Locy and M. M. Metcalf (Central Branch).

The following papers were presented at the meeting, either in full or by title:

The Sense of Smell in Necturus maculatus: R. E. SHELDON, University of Pittsburgh.

Conjugation and its Significance in the Ciliate, Didinium: S. O. MAST, Johns Hopkins University.

Didinia about to conjugate decrease nearly three fourths in size, and the anterior ends become considerably flattened. They find each other by random movements, join anterior end to anterior end and remain together from four to twelve hours or longer, depending largely upon the tem-

perature. The nuclear changes are similar to those found in *Paramecium*. A large percentage of exconjugants usually die, but sometimes all live. The proportion of fatalities is essentially the same in small individuals taken from the same culture but not allowed to conjugate, while large individuals nearly all live. There is no evidence indicating that there is any difference in the vitality of the two individuals of conjugating pairs foreshadowing sexual differentiation, as held by some investigators. The rate of fission is apparently not affected by conjugation, and if there is a rhythm in the rate of division, such as has been described for certain other infusoria, it is independent of conjugation as is shown by the following results. In seven closely related families under the same environmental conditions the rate of fission was practically the same during a period of several weeks, although the number of generations since conjugation at the close of the experiment varied in the different families from 123 to 553. Conjugation is almost invariably accompanied by encystment, *i. e.*, when certain individuals in a culture conjugate others encyst. This seems to indicate that conjugation, like encystment, functions in bridging over periods of unfavorable environmental conditions. Conjugation produces an increase in physiological variability; some of the exconjugants consequently have a better chance to survive under adverse conditions than do those which have not conjugated.

Behavior of Fire-flies (Photinus ardens?) with special Reference to the Problem of Orientation: S. O. MAST, Johns Hopkins University.

The fire-flies studied are found in dark crevices or under ground during the day. In the evening when it is still light enough to read they come out; the females crawl to the tips of grass or other objects and remain quiet; the males fly about and glow fairly regularly at intervals of about five seconds. The females do not glow unless light from the males or from some other source is flashed on them. When a female glows in response to the glow of a male, the male ordinarily turns directly toward her. This is repeated until the two come together, after which copulation takes place. There are no other factors involved in mating. If a female is held near a male he pays no attention to her unless there is actual contact, showing that neither objective vision nor smell is functional in mating. The males do not orient when exposed to continuous illumination. They respond only to flashes of light, and do not react until after the light has disappeared. Thus orientation may take place in total darkness, and it is surprising how accurately these animals turn through the proper angle in the total absence of the stimulating agent that caused the response. Here we have a case in which it is clearly demonstrated that light does not act continuously in the process of orientation as demanded by Loeb's theories, a case in which it is also clearly demonstrated that continuous stimulation is not necessary to keep the organism oriented.

Expermients with the Influence of Darkness upon Pigment Development in Amphibian Larvæ: A. M. BANTA, Station for Experimental Evolution.

From newly laid eggs series of *Amblystoma tigrinum* were reared (1) in darkness and (2) in ordinary laboratory light, and compared with those developing (3) in the pool where the eggs were laid. The amount of pigment developed in each individual of the different series was determined by means of color tops, and records were made in terms of the percentages of black, white, orange and yellow, which when blended matched the color of the animal's skin. For the salamanders on the average the body color of the series reared in darkness contained 49.7 per cent. black and 50.3 per cent. non-black (16.9 white, 9.3 orange and 24.1 yellow); the series reared in laboratory light averaged 86.1 black and 13.9 non-black (4.7 white, 2.4 orange and 6.8 yellow); and the series examined from the outdoor pool averaged 86.6 black and 13.4 non-black (4.5 white, 3.1 orange and 5.8 yellow). Hence the salamanders reared in darkness contained about four times as much non-black in the body color as those reared in daylight in the laboratory or in the outdoor pool where the eggs were laid. The darkest individual in the series reared in darkness, with 70.5 black, was much lighter than the lightest, with 82 black, of either of the series reared in the light.

To be published in full in *The American Naturalist.*

A Comparison of the Light Reactions of a Subterranean and an Epigeal Race of an Amphipod Species: A. M. BANTA, Station for Experimental Evolution.

The Spawning Habits of the Sea Lamprey, Petromyzon marinus: L. HUSSAKOF, American Museum of Natural History.

The observations were made on the Nissequogue River at Smithtown, Long Island, June 1 and 2,

1911, while collecting material for an exhibition group of *Petromyzon* for the American Museum. The nests are depressions in the gravel of the river-bottom, two to three feet in diameter, and six inches deep at the center. The method of their construction and the general behavior of the specimens on the nest are very similar to those of the Brook Lamprey. But owing to the large size of this species all its movements can be minutely observed.

To be published in full in *The American Naturalist.*

On the Factors that Determine the Location of the Borings of the Yellow-bellied Sapsucker on the Paper Birch: MARGARET W. TAGGART, University of Illinois. (Introduced by Jacob Reighard.)

The aim of the present study is to determine the details of the work of the yellow-bellied sapsucker (*Sphrapicus varius varius*) upon the paper birch (*Betula alba paprifera*). The borings of the sapsucker on the birch are distributed in several separate areas on a single tree. These individual holes are arranged in definite rows: they are distinct, small, numerous and are rarely confluent. The birds as they excavate eat the sap and cambium of the tree and also the insects attracted by the liberated sap. The factors involved in an explanation of the distribution of the groups of holes and in the shape and arrangement of the individual borings are two—the woodpecker instinct to bore holes and the mechanical conditions under which the bird works. The mechanical conditions resolve themselves into: (1) The perching of the bird. The sapsucker perches on knots and rough places on the bark, rather than on the smooth bark, and uses the excavations it has made in preference to the knots, because they afford a firmer foothold. (2) The structure of the bark. The shape of individual holes and the arrangement of series of holes in vertical colums is determined by the structure of the bark. (3) The use of the cambium as an article of diet. A flow of sap is released by the use of the cambium as an article of diet. The sap attracts insects as a purely incidental result of the bird's work. (4) The cleaning up of all the cambium around the edges of the holes. The large denuded areas are formed as an accidental accompaniment to cleaning up all the cambium around the edges of the holes, and may or may not appear on a given tree. Any explanation, therefore, which involves instinct or intelligence, more than the general woodpecker instinct to make small holes, is unnecessary. The external factors are an adequate explanation of the facts in the case.

Provisional Tabulation of Some Brain Collections with Special Reference to their Usefulness for Taxonomic Purposes: BURT G. WILDER, Cornell University.

The Brain of the New Goblin Shark: WILLIAM A. LOCY, Northwestern University.

Control by the Sympathetic Nervous System and its Morphological Basis: ALBERT KUNTZ, University of Iowa.

To be published in the *Journal of Comparative Neurology.*

Nervous and Non-nervous Responses of Actinians: G. H. PARKER, Harvard University.

A few seconds after a mechanical or a chemical stimulus has been applied to the ectoderm of the lower part of the column of a sea-anemone (*Metridium marginatum*), the animal will respond by contracting the longitudinal entodermic muscles of the mesenteries, whereby the oral disk becomes retracted and ultimately covered by the action of the ring-muscle. The fibrillar layer in the base of the ectoderm and entoderm, believed by the Hertwigs to be the nervous layer, does not offer an easy means of explaining this reaction, since it does not connect the ectoderm in any direct way with the longitudinal mesenteric muscles. Neither does this layer become stained or impregnated by any of the ordinary methods used for the demonstration of nerve-cells or neurofibrils. By a modified silver method devised by Dr. E. G. Titus, a rich system of neurofibrils can be demonstrated in the supporting lamella of the column. These fibrils penetrate the ectoderm and reach through the supporting lamella of the mesenteries to the longitudinal mesenteric muscles. They are the essential nervous elements in the retraction reflex just mentioned.

When a sea-anemone is cut nearly in two, nervous transmission from one piece to the other can be accomplished through almost any part of the body of the animal except the lips. Yet in the lips the so-called nervous layer of the Hertwigs is as well developed as in any other part of the body. This layer, therefore, probably is not the true nervous system; the true nervous system consists of the nervous elements imbedded in the supporting lamella. The layer described by the Hertwigs as nervous is composed of the fine basal branches of the epithelial cells and may be a mechanism for

the absorption of nourishment from the fluids of the intervening spaces.

If a mechanical stimulus is applied to the middle of the column of a *Metridium*, in somewhat less than a minute a well-marked constriction encircles the animal, due to the contraction of the circular muscles of the column. This constriction will occur on a column whose ectodermic surface has been anesthetized with magnesium sulphate to such an extent that the characteristic retraction reflex can not be called forth from it. It is therefore probably a non-nervous direct response of the muscle comparable to the direct responses already demonstrated in the muscles of some sponges.

The Structural Changes during the Contraction of Mollusk Muscle: ULRIC DAHLGREN, Princeton University.

The Organs of Equilibration in Pelecypod Mollusks: ULRIC DAHLGREN, Princeton University.

Preliminary Chemical Studies on Male and Female Producing Eggs of Pigeons: A Study of the Eggs of Forms in which the Dominance of Male and Female Sex and of White and Dark Color was Experimentally Determined by Professor C. O. Whitman: OSCAR RIDDLE, University of Chicago.

Much more important than the results of these preliminary chemical studies are the hitherto unannounced facts upon which the studies are based. One of the remarkable results achieved by Professor Whitman in his work with pigeons is the experimental control of the *sex* and *color* of the offspring of certain crosses of pigeons. That is to say, one and the same pair of birds can now be made to produce only dark male offspring—in spring and early summer, and when birds are young and in full reproductive vigor; and likewise only white female offspring—in late summer and autumn, and when birds are very old. The method consists simply in the choice of birds of known age and vigor for the matings, and then *removing their eggs as fast as laid to other birds—thus forcing the birds throughout the year to their maximum of egg-production.* All of the first several pairs of eggs produce dark male hybrids; while all of the last several pairs produce white female hybrids. A short transition period intervenes in which the sex and color of the progeny can not be foretold. There is usually a final period in which eggs are produced capable of little, and of *no* development. Birds thus treated over a period of years show that fewer and fewer males are produced each succeeding year, and that the *time* of appearance of female-producing eggs is moved more and more toward the beginning of the season. Finally, matings of very old birds can be made in which it can be definitely foretold that *only* white female offspring will be produced. These results have been verified yearly since 1903. It is necessary of course to mate individuals of two different species, varieties or hybrids (one bird *dark* the other *light* if color is to be controlled) for such control. Four pure species (reciprocal crosses) and four different kinds of hybrids were successfully used in this way. Stated in Mendelian terms—terms which Professor Whitman did *not* think it well to use—he was able to shift, control or determine experimentally the dominance of sex and color. Aside from the fact that this discovery by Professor Whitman furnishes a starting point and a background for my chemical studies, it unfortunately seems necessary to emphasize at this time, that, although Professor Whitman had never announced this result, he had obtained it as early as 1903; and that this result —confidentially communicated—has been well known to his colleagues at the University of Chicago practically since that time.

The result of a limited number of parallel incubations and analyses made in 1911 on the male-producing and female-producing eggs obtained from the above-mentioned crosses indicate (number too small for final decision): (1) That eggs of *smaller size, higher water content* and *smaller energy content* (*i. e.*, fewer units of physiologically available energy) can be *correlated* with *maleness* and *dark color* in the offspring. (2) That eggs of *larger size, lower water content* and *greater energy content* can be *correlated* with *femaleness* and *white color* in the offspring.

On a Relation Found to Exist between Changes in the Chemical Composition of a Membrane and Changes in its Permeability: OSCAR RIDDLE and ADELAIDE A. SPOHN, University of Chicago.

The follicular membrane can be taken for analysis at three different phases of its normal permeability to the constituents of yolk, viz: (1) When these constituents are penetrating the membrane very slowly; (2) when a sudden and very great increase in this rate of penetration occurs; and (3) the period following this increase and during which the greatly increased permeability is also accompanied by a rapid proliferation of the component cells of the membrane. Analyses show that in phase (1) when the permeability and

growth of this membrane are moderate in amount, the lecithin content of the membrane is of medium value (9 per cent.). At phase (2) the lecithin content is high (15–23 per cent.). During phase (3) the lecithin content again assumes a medium value (8.5 per cent.). The fat content is much lowest at phase (2) (=traces). In phases (1) and (3) this figure is 6 per cent. and 7 per cent., respectively. It has been shown that these values are not produced by variable amounts of contaminating yolk. The results seem to lend some support to Overton's theory of the lipoid nature of the cell membrane; and indeed to indicate that that theory may be extended so as to apply to a *membrane of cells*. At any rate, here is one case where changes in degree of permeability of a *cellular* membrane to *substances rich in fat* (yolk) are preceded or accompanied by a change in the lecithin content of the component *cells* of the membrane.

Some Chemical and Hybridization Experiments in Invertebrates: MAX MORSE, Trinity College.

A number of crosses were attempted at the Harpswell Laboratory, South Harpswell, Maine, between the nemertean, *Cerebratulus,* and various invertebrates, such as *Echinarachnius, Ilyanassa, Strongylocentrotus* and others, both by simple mixing of eggs and sperms and by the application of hypertonic solutions and other reagents known by previous experiments to cause polar bodies to form or even to induce the earlier morula divisions of the egg. Of the several crosses attempted, only one was in any degree successful, this being *Cerebratulus* egg by *Ilyanassa* sperm, the polar bodies being extruded and the earlier segmentations passed through. However, even here it was found impossible to prolong the growth of the embryo to gastrulation, although temperature, salinity, alkalinity and other factors were considered. The cross in question was checked against errors in manipulation, contamination, etc. No experiment made according to the methods of Godlewski, Kupelwieser, *et al.,* where excessive amounts of sperm were used, were successful, nor were experiments involving normal fertilization, preceded by or followed by hypertonic or other parthenogenetic reagents, successful in causing even polar bodies to form. Hence *Cerebratulus* is similar to several other forms where attempted hybridization was found to be futile.

A Comparison of the Retardation Produced by Rapid and Slow Electrons (Beta Radiations) of Radium in the Growth of Various Seedlings and a Consideration of the Relative Importance of Chemical and Physical Factors in the Process: E. D. CONGDON, Cornell University Medical College.

The method of comparing the effect of the rapid and the slow electrons consisted in the exposure of one lot of dry seeds (*Synapis nigra, Panicum germanicum, Amaranthus monstrosus, Nicotiana tobacum* and *Papaver somniferum*) to rapid electrons and another lot to a like intensity of rapid electrons plus secondary slow electrons coming from a lead tube. Both sets showed a retardation which decreased in amount with shortened exposure. The slow electrons had one fourth as great ionizing power in the air as the rapid electrons. Their retarding effect, however, was much greater than one fourth that of the rapid. In one case it was twice as great. Therefore, when very small seeds are taken so that the non-penetrating electrons can distribute their effect through the whole seed, the slow electrons, relative to their ionizing power in the air, are much more biologically effective than the rapid. It was also found that absence of seed coat increased greatly the effect, not only of the slow (non-penetrating) but of the rapid (penetrating) electrons. The placing of the embryo side of the seed toward the radium had a like effect. Those seeds with the greatest diameter were least retarded, and *vice versa.* Thus even in such small organisms, the largest having a diameter of only 0.67 mm., factors governing absorption play a great rôle in determining their sensitiveness. To determine the importance of chemical make up, pairs of seeds of like diameters but very unlike constitution as to starch and fat were exposed. The testa had been removed and the embryos all turned toward the radium. The pairs of species having seeds of like diameters showed almost identical degrees of retardation. The differing sensitiveness of the species here used must then be referred to physical rather than chemical differences in the seeds.

Studies in Developmental Energetics. I. The Changes in Chemical Energy during the Development of Fundulus heteroclitus: OTTO GLASER, University of Michigan.

Studies on the Artificial Production of Grafted and Multiple Embryos: A. J. GOLDFARB, College of the City of New York.

By a modification of the Herbst method of treating sea-urchin eggs, it was possible to produce either (1) fertilized eggs without their membranes, and with the blastomeres completely separated, (2) the same but with the blastomeres only partially

separated, (3) the loose union of one or more eggs or parts thereof, (4) the greater or less fusion of one and one half to sixteen or more eggs into one large complex.

Observations upon living and preserved materials clearly showed the nature of the subsequent history depended upon the nature of the union of the component eggs. When eggs or parts of eggs were either partially separated or brought in loose contact, the development of the component eggs was independent, showing no influence of the one upon the others. Two or more normal plutei resulted, either separate or welded together into twins. A very considerable number showed varying stages in the fusion and regulation whereby several blastulæ or gastrulæ were reorganized into one giant or irregular single blastula, gastrula or pluteus. These changes involved interesting regulatory processes in the skeleton, gut, size, shape, etc., of the individual eggs. They also showed an independent rate of development with a frequent dominance of one and the gradual reduction and disorganization of the other eggs in such a partially fused mass of eggs.

Common Atypical Embryos and the Diverse Methods by which they are Produced: A. J. Goldfarb, College of the City of New York.

The Influence of Magnesium Chloride on the Fertilizing Potential of Spermatozoa: R. A. Budington, Oberlin College.

The sperm of *Arbacia punctulata* was used. This was treated for various lengths of time (5 to 80 minutes) with different solutions of MgCl in sea water; .1, .2, .3, .4, .5 and .6 gm. solutions were employed. Such sperm was then used in artificially fertilizing eggs of the same species, two questions being kept in mind, viz., (*a*) Will such sperm cause earlier cleavage of eggs than will normal sperm? (*b*) Will such sperm fertilize a larger percentage of eggs than will normal sperm? A positive result was obtained for the first problem when sperm were exposed to weak solutions for 5 to 15 minutes. As to the second problem, no marked increase in relative number of eggs fertilized, over the proportions shown by the control, could be detected.

The complete paper will probably be published in *The Biological Bulletin.*

The Effect of Narcotics upon the Development of the Hen's Egg: A. M. Reese, West Virginia University.

To be published in Science.

Effect of Commensal Plant Cells in Altering the Rate of Starvation in Scyphomedusæ: Alfred G. Mayer, Carnegie Institution of Washington.

The scyphomedusa *Cassiopea xamachana,* of Tortugas, Florida, is infested with Zooxanthellæ, which when exposed to daylight operate through photo-synthesis to fix the carbon given off as a result of the medusa's metabolism, and at the same time to set oxygen free, thus serving as an efficient aid to the vital processes of the medusa. If the medusæ be maintained in darkness, the zooxanthellæ are rendered inactive, and the medusa starves more rapidly than if exposed to the diffuse light of the laboratory. In darkness the course of starvation is represented by the formula

$$y = W(1-a)^x,$$

where y is the weight upon any day x after starving has begun, and W is the original weight when starving began. a is the index of starvation, for it increases as the rate of starvation increases. When the medusæ are starved in darkness, a ranges from .075 to .205, but in diffuse daylight it is less, varying from .046 to .15. When the medusæ are starved in diffuse daylight they lose weight more slowly than if in the dark, and the formula for starving in the light may be represented by

$$\begin{aligned} y = {} & W(1-a)^x + \Delta\left(\frac{w + w(1+\beta-\theta)}{2}\right) \\ & \times [(1-a)^{x-1} + (1-a)^{x-2}(1+\beta-\theta) \\ & + (1-a)^{x-3}(1+\beta-\theta)^2 \\ & + \text{etc.} \ldots (1-a)^{x-x}(1+\beta-\theta)^{x-1}] \\ & + w(1+\beta-\theta)^x, \end{aligned}$$

where w is the original weight of plant cells in the medusa, β their coefficient of increase, θ their coefficient of mortality, and Δ the coefficient of assimilation of these cells by the medusa. The medusæ may be starved 41 days, and still remain alive when their weight has been reduced to one hundredth of its original mass. If starved in sea-water which has been sterilized by heating to 72° C., and then cooled to normal temperatures, the medusæ lose weight about 1½ times more rap-

	Movements Cease at	Temperature of Greatest Activity	Movements Cease at	Death Occurs at
Aurellia from Tortugas	7°.75 to 11°.8 C.	About 28° C.	36°.4 to 38°.4	38°.5
Aurellia from Halifax, Nova Scotia	—1°.4	18° to 23°	29° to 29°.7	29° to 30°

idly than if starved in sea-water which has been passed through filter paper but not heated. This leads one to suspect that Pütter's "dissolved food" in sea-water may not be available unless some bacteria or other organisms be present in the sea-water to stimulate or maintain a synthesis of the inorganic ingredients of sea-water that may result in building up the animal body. In other words, sea-water as such may not be a nutrient fluid for animals unless acted upon by certain plant-like organisms in the immediate presence of the animal itself. As a side issue of this research, it appears that the so-called "converse relation between ciliary and muscular movements" in ctenophores, trochophores, veliger larvæ, etc., is not a chemical but merely a mechanical matter. When the muscles contract pressure is brought to bear upon the ciliated cells, and this renders them relatively insensitive to stimuli and the cilia stop; *vice versa* when the muscles relax, as under the influence of magnesium, the normal stretching of the cilia-bearing epithelium is reduced and the cilia are free to beat incessantly, as do isolated cilia-bearing cells when mechanically torn away from the epithelium and set free in the water.

This paper may appear in the forthcoming volumes of "Researches from the Tortugas Laboratory of the Carnegie Institution of Washington."

The Temperature Reactions of Medusæ Ranging from Temperate to Tropical Oceans: ALFRED G. MAYER, the Carnegie Institution of Washington.

In species of *Aurellia, Limulus* and *Pennaria* which range from cold to warm seas, it is found that individuals living in the tropics have a higher optimum and a higher death temperature than have those living in cold seas. Also the individuals in the tropics can not withstand such low temperatures as do individuals of the same species in cold seas. For example, consider the case of *Aurellia aurita,* the common scyphomedusa, which ranges from pole to pole and is found in all oceans: *Aurellia aurita* from Tortugas, Florida, is killed if frozen into the ice, but specimens from Halifax, Nova Scotia, survive this treatment.

A strictly tropical medusa, such as *Cassiopea frondosa* is killed at from 8°.2 to 9°.7 C., but it continues to pulsate up to about 38°.3–40° C. Evidently it could not survive in cold seas, and this may account for the fact that not a single species of *Cassiopea* has ever been found in the temperate regions. On the other hand, a form confined to arctic or cold seas, such as *Cyanea arctica* from Halifax, Nova Scotia, pulsates until frozen into the ice, a treatment which causes it no apparent injury. On the other hand it is killed by 30° C. Thus it could not survive in the surface waters of the tropics and no *Cyanea* has yet been found in tropical waters. On the other hand the case of *Limulus* shows us that temperature resistance is by no means a sole factor in determining the geographical range of animals, for on the Massachusetts coast *Limulus* remains active from —1°.1 to 41° C. and at the Marquesas Keys in Florida from 0.8° to 45°.7 C. Yet it ranges only from Maine to Yucatan, and all attempts to introduce it upon the coast of Europe have failed.

This paper may appear in the forthcoming volume 5 of "Researches from the Tortugas Laboratory of the Carnegie Institution of Washington."

Symmetry in Regeneration: HERBERT W. RAND, Harvard University.

When a bilaterally symmetrical metazoan is bisected in a plane oblique to its long axis, regeneration, if it occurs, takes place in such manner that asymmetry, in the ordinary geometrical sense of that word, persists until regeneration is nearly or quite completed. The literature dealing with such experiments contains many descriptions which indicate or suggest that the new part, in the earlier stages of its regeneration, lacks, as regards form and organization, coordination with the old part; and that coordination of new and old parts to constitute a normal whole is secondarily effected by means of organogenetic and regulatory processes.

These descriptions give rise to misconceptions regarding the true nature of the regenerative process. A reinvestigation of regeneration from oblique surfaces in planarians reveals evidence that the new material is, from the very beginning of the regenerative process, in the highest degree coordinated with the old. While, during regeneration, the total material is asymmetrical in a geometrical sense, nevertheless a perfect organic symmetry exists in the sense that such materials and energies as are present are distributed upon either side of a morphological median surface (not a plane surface) with precise regard to a certain completeness of plan which remains to be worked out only in a quantitative way. This unity of organization certainly exists from the moment when the formation of new tissue begins—perhaps even before regeneration is outwardly manifested.

The Larva of Sarcophaga, a Parasite of Cistudo Carolina, and the Histology of its Respiratory Apparatus: WM. A. KEPNER, University of Virginia.

This *Sarcophaga* has only been observed three times. Packard discovered it first. He took it to be an Œstrid larva. Wheeler later succeeded in raising imagines from the larvæ and found that the flies belonged to the genus *Sarcophaga.* A careful study of the larvæ taken from a *Cistudo Carolina* in Virginia also revealed that these were larvæ of a *Sarcophaga* and not those of an Œstrid. The anterior stigmata are laterally compressed fan-shaped processes. Each stigma represents for the most part a proliferated mass of the two-layered cuticle of the general surface. At its wide free end the anterior stigma bears 16 to 18 finger-like papillæ. At the tip of each papilla there is a pore which opens into a branch of the lumen of the stigma. The lumen of this anterior stigma is filled with a finely reticulated plug of chitin. Just as the tænidia of the main trachea are given off by the inner, denser cuticular lining of the trachea so the reticulated plug is given off by the inner, denser layer of the cuticular substance of the anterior stigma. The larvæ spend three or four days in emerging from the skin of the host. It is inferred that during this time the anterior stigma are functional, and that the reticulated plugs act as bacterial screens for the two main tracheal trunks.

The complete paper will be published in the *Biological Bulletin.*

The Intra-uterine Embryo of the Bonnet-head Shark, Sphyrna tiburo: E. W. GUDGER, State Normal College, Greensboro, N. C.

This shark is viviparous, but viviparity is not attained by a villous uterus secreting a "milk" as in *Dasyatis say* and *Pteroplatea maclura,* two rays common on our Atlantic coast. The inner mucous lining of the uterus is separated from the outer muscular coat by a fibrous spongy material, hence considerable growth of the embryos may take place before any distension of the outer wall is necessary. The embryos in the fish captured measure 50 mm. in length. They lie nested in the cavity of the uterus, each in a separate spindle-shaped compartment or depression in the mucous lining. The embryos have a large number of external gill-filaments 15–18 mm. long protruding from the gill-slits. The umbilical cord is about 50 mm. long and is closely beset with what Alcock has called "appendicula," large clear villi-like structures, sometimes single, sometimes forked. The yolk-sac is large and flat. Each egg with its embryo is contained within a very thin but tough and elastic membrane, highly iridescent in appearance. The ends of this shell are curiously plaited and folded and when unfolded the shell becomes of great length. The purpose of this seems to be to accommodate the growing embryo, since Alcock found the 18-inch young of *Zygæna blochii,* the Indian Hammer-head, still enclosed in the shell. The same authority reports that the emptied yolk-sac becomes adherent to the wall of the uterus and thus becomes a functional placenta. The embryos under consideration are too young to show anything of this kind. The function of the "appendicula" is not known. The data given are from a shark studied at the Beaufort, North Carolina, Laboratory of the United States Bureau of Fisheries.

This abstract represents a part of a paper on "Viviparity in Beaufort, N. C., Sharks and Rays," which will probably be published in the *Bulletin of the U. S. Bureau of Fisheries.*

Amitosis in Testes of Tænia Serrata: R. T. YOUNG, University of North Dakota.

Occasional evidence of amitosis is found in early stages of these organs, consisting in (1) cells which show distinct incisions of the cytoplasm, (2) cells with straight or nearly straight edges separated by narrow spaces, as though recently broken apart, and (3) bi-nucleate cells constricted between the nuclei.

Epithelium of Plathelminths: R. T. YOUNG, University of North Dakota.

To be published in the *Journal of Morphology.*

Some Uses of Celluloid in the Biological Laboratory: J. S. KINGSLEY, Tufts College.

Small skeletons like those of the frog and *Necturus,* bleached tests of sea-urchins, etc., are sure to be quickly destroyed by students unless protected in some way. For some years I have used boxes of glass, fastened together with paper or tape, for this purpose, but recently, acting on a hint from Dr. Gast, of the Naples Zoological Station, I have made the boxes of transparent sheet celluloid, sometimes with one side of glass. The celluloid is such as is employed for automobile wind-shields and comes in sheets measuring 20 by 36 inches. The thickness is accurately gauged and is in multiples of 5/1000 of an inch. I have mostly employed 10/1000 and 15/1000, the cost of the former being 75 cents, the latter $1.00 a sheet.

The celluloid is cut with the shears to the required size and shape and the boxes are built by cementing the edges of the sheets by bringing them into the desired position and then moistening them with acetone applied with a small brush. Less than a minute is required for the firm adhesion of the edges. In the same way the celluloid can be fastened to the edges of a light of glass, provided that the edges of the latter be clean. Of course considerable care must be exercised to see that all pieces of celluloid be accurate in size. The details of the operations are not easily described, but a little experience will enable any one to devise methods to meet all cases. The specimen can be fastened to the glass or celluloid by means of scraps of the waste celluloid dissolved in acetone. I have now fluid specimens mounted in "Wilson's oil" and enclosed in boxes of celluloid, built up in the same manner, which have been in good condition for several months. How permanent they will prove, time can only decide. It is impossible to mount them in alcohol or formol as water or alcohol dissolve the camphor and other substances in the celluloid. In the case of Wilson's oil the box must be completely filled or there will be a warping of the celluloid which will break down the box in a few days. I believe that celluloid can be used to fasten the tops to the square museum jars, but I have not tried it. I may suggest that strips of celluloid be fastened to the ground edge of the jar by acetone, the jar be then filled as completely as possible with the preserving fluid without wetting the edge of the celluloid, and then the cover applied, acetone being run in with a brush, and then a solution of celluloid in acetone being painted over the joint. It seems probable that, with such a thin layer of celluloid, there would not be sufficient warping to break the joint. It is often desirable to mount rather thick microscopic objects under pressure. I have used the following process in thus mounting parapodia of annelids. Two narrow strips of sheet celluloid are placed on a slide in the desired position and are then cemented to the slide by running acetone under them. The object, properly cleared, is placed between the strips, and the cover-glass pressed down and fastened in position with acetone run under. In two or three minutes balsam or dammar is drawn under the cover by capillary attraction and the slide is permanently mounted. I may say that the sheet celluloid is to be had in every large city. I have bought my supplies of Willard and Willard, 65 Bedford Street, Boston. The scraps from other operations may be used, instead of gun-cotton or celloidin, for section cutting, being dissolved in alcohol and ether in the customary manner.

Parasites of the Muskrat: F. D. BARKER, University of Nebraska.

On the Number of Known Species of Animals: H. S. PRATT, Haverford College.

The first enumeration of all the species of animals known to science was made by Linnæus in 1758. In the tenth edition of the "Systema Naturæ" he described 4,236 species, which were apportioned among the various larger groups (which are here given their modern names) as follows:

Mammals	183
Birds	444
Birds and Amphibians	181
Fishes	414
Tunicates	3
Bryozoa	35
Mollusks and Brachiopods	674
Crustaceans	89
Arachnids	78
Myriapods	16
Insects	1,936
Worms	41
Echinoderms	29
Cœlenterata	74
Sponges	11
Protozoa	28

About a hundred years later (1859) Agassiz and Bronn made the following enumeration:

Vertebrata	18,660
Mollusks	11,600
Crustaceans	1,500
Arachnids	2,000
Insects	90,000
Worms	1,600
Echinoderms	550
Cœlenterates	1,820
Sponges	290
Protozoa	1,510
	129,530

In Ludwig's revision of "Leunis," published in 1886, the numbers of species are given as follows:

Mammals	2,300
Birds	10,000
Reptiles	2,500
Amphibians	1,000
Fishes	9,000
Tunicates	300
Mollusks	21,320

Crustaceans	5,600
Arachnids	4,000
Myriapods	800
Insects	200,000
Worms	6,300
Echinoderms	2,370
Cœlenterates	3,000
Sponges	600
Protozoa	4,130
	273,220

An estimate of the number of living species known at the present time (1911) gives the following results:

Mammals	3,500
Birds	13,000
Reptiles	3,500
Amphibians	1,400
Fishes	13,000
Tunicates	1,300
Mollusks	61,000
Crustaceans	16,000
Arachnids	16,000
Myriapods	2,000
Insects	360,000
Annelids	4,000
Bryozoa	1,700
Rotifers	500
Nemathelminthes	1,500
Plathelminthes	5,000
Echinoderms	4,000
Cœlenterates	4,500
Sponges	2,500
Protozoa	8,000
	522,400

Some Changes in the Nerve Cells of the Bee during its Life Cycle: W. M. Smallwood, C. G. Rogers and Ruth L. Phillips, Syracuse University.

Ecological Observations in British Guiana and Brazil: Henry E. Crampton, Columbia University. (Illustrated with lantern slides.)

An Early Human Cranium from Unterlesece near Trieste: Harris Hawthorne Wilder, Smith College.

A fragmentary human cranium was exhibited which was excavated during the past summer in a cave in the small Slavic village of Unterlesece, 15 kilometers east of Trieste, Austria. The cavern is a mere cleft, not offering sufficient headroom to allow one to stand, or even sit, except at the very end, and could not have served for a dwelling. The deposits, therefore, consist of the things that have washed in and lodged in the hollows of the floor. They consist mainly of the bones of Neolithic animals, and a few Neolithic shards. This fragment was found, associated with a right ulna, and a small shard of crude workmanship, in a bottom layer of clay, and covered by a distinct layer of loess, with stone fragments from the roof, among which were imbedded bones of the ox, sheep, horse, etc., also many pieces of a human skeleton with worn teeth, as in the American aborigines. The results of the detailed anthropometric measurements, of which 37 were taken, conform closely to certain other ancient skulls of the *sapiens* species, especially those of Egisheim, Cannstatt, Brunn, I. (1885), and probably Tilbury and Sligo. While, however, these latter are pretty definitely Quaternary (Solutrean, Magdalenian), this specimen, as dated by the shard and the general character of the remains in the cavern, must be either Neolithic or Transneolithic (Campignyan, Tardenoisian).

Evidence of Evolution in the Mechanism of Inheritance: Maynard M. Metcalf, Oberlin College.

In some, perhaps in all, of the higher animals and plants the chromatin consists of discrete particles of different functions in physiologic activity and inheritance. These particles are grouped into chromosomes in which, in some species—perhaps in all—they form linear aggregates. There is an elaborate achromatic mechanism of mitosis which aids in securing the distribution of halves (?) of each discrete particle of chromatin to each of the two daughter nuclei. In many plasmodrome protozoa (perhaps in some stage of their life history in all of them) the nucleus contains a caryosome with a definite caryole and an outer membrane delimiting it from the peripheral zone of the nucleus. New granules of chromatin continually form in the caryosome (apparently at the caryole), wander to the caryosome membrane, after a time break through this into the peripheral zone of the nucleus, through which they migrate to reach the caryotheca. Many of these granules in time break through the caryotheca into the cytoplasm as chromidia, there to be dissolved. Apparently any of the granules so formed in the nucleus may become chromidia. The most careful study of these nuclei shows no indication of division of the chromatin granules within the nucleus during this formation of chromidia. Whole granules seem to be thrown off. Such a condition seems incompatible with the existence of a series of "determiners" in the nuclei of plasmodroma. The chromatin seems rather more homogeneous, each particle having the

same physiologic and inheritance value as every other except perhaps for size or density. This condition parallels the general physiological condition in the plasmodroma whose protoplasm shows little differentiation for sensation, conduction, locomotion or specialized secretory activities, each bit of the protoplasm sharing in all these activities. In other protozoa we find several different types of more highly evolved chromatin structure. Some of these, as in *Opalina,* seem not in the line of evolution of the metazoan condition. Others, as in *Paramecium,* have chromosomes which are linear aggregates of granules and which split longitudinally in mitosis. Such a form has a chromatin arrangement which would allow differentiation of the granules into divergent determiners, for a portion of each granule is given in mitosis to each daughter nucleus.

A further discussion of this subject is in preparation. Its place of publication is not yet determined.

Opalina mitotica: MAYNARD M. METCALF, Oberlin College.

This paper, which was read by title only, will soon appear in full in one of the Spengel Festschrift volumes of the *Zoologischer Jahrbücher.*

The Pædogamous Conjugation of Blepharisma: GARY N. CALKINS, Columbia University.

There is some question as to the specific name of the organism with which I am working. Up to the present I have followed Butschli in calling it *B. musculus,* identifying it with the form *Urostyla musculus* described by Ehrenberg. The name *Blepharisma* goes back only to Perty in 1849, who first used it as a generic name for a species of *Spirostomum* described by Ehrenberg again, as *Spirostomum lateritia.* Leaving for the present the taxonomic position of the organism I wish to speak here more particularly of some of the biological phenomena which have come under observation during the five months that I have kept *Blepharisma* under culture. I isolated a specimen in July from pond water at Woods Hole and found that it lends itself readily to cultivation upon artificial media. For the best results a few drops of pond water plus a drop of 24-hour standard hay infusion are now used, a medium upon which the organisms have reached to-day the 160th generation. None of the earlier observers made out a micronucleus and from total preparations alone I was unable to demonstrate it. Upon study of sections of the organisms, however, I have been able to find structures which undoubtedly correspond with a micronucleus in the typical ciliate. The macronucleus is large and comparatively easy to demonstrate, although it has a variety of forms; sometimes it is a single body of spheroidal form, again it breaks up into irregular fragments. On division there are two chief portions, one at either end, and a connecting strand of somewhat different texture and the micronuclei are connected with this. It is the custom of all who carry on careful culture work to isolate one individual and supply it with fresh medium every day. The individuals left over after isolation of the one specimen are placed in larger vessels and kept as "stock." Early in the summer it was seen that endogamous conjugations occurred frequently in this stock material, in some cases reaching the proportions of a general epidemic. So keen at times is this "sexual hunger" as Maupas called it, that conjugation occurs between the closest related cells. For example an individual was isolated in the 104th generation, fresh medium and food being given as usual. On the following day it had divided, but the two sister cells were united in typical conjugation. This, I believe, is the closest relation on record for pædogamous conjugants amongst Infusoria. The cells begin to conjugate at the anterior tips as in *Paramecium* and gradual fusion extends along the peristome for about two thirds of the length and never further, thus leaving the greater portion of the undulating membrane and the mouth entirely free. They remain in conjugation from 12 to 24 hours and separate through vacuolization of the connecting zone of protoplasm. The most remarkable phenomena are connected with the nuclear relations during conjugation on which I can now give only fragmentary notes, as my observations are not completed. The macronucleus becomes compact and spheroidal with a typical "kernspalt" in the center. It is also enclosed in a firm resistant membrane like a cyst, a structure which does not exist at other times. Sections of conjugating pairs show that the nucleus is made up at this time of two main bodies of chromatin of densely granular appearance, while between them long drawn-out rods of chromatin like chromosomes appear to be dividing. This central material gives rise to two smaller nuclei which are freed from the mass of macronuclear material and in the cytoplasm undergo one or two further divisions which result in the gametic nuclei. I have not yet found the pronuclei in the process of fusion, but have seen them in the connecting bridge between the

two organisms. Here then is something entirely novel in the make-up of macro- and micronuclei, the micronucleus being absorbed and protected by the macronucleus. The size statistics of conjugating and non-conjugating forms are similar in essence to those of *Paramecium*. Miss Watters has measused some 1,580 specimens, of which 482 were conjugating. The average size of the conjugants is 110 μ, of non-conjugants 140 μ, the latter including exconjugants which never regain normal size. More than 150 exconjugants have been isolated and maintained from time to time. Not one has lived more than 16 days, the dates being 22 per cent. dead on first day, 31 per cent. on second, 13 per cent. on third and 8 per cent. on fourth, with the rest scattering one or two per day until the sixteenth. This is similar to Bütschli's results with Blepharisma in 1876, when all of the ex-conjugants died within three days after separating. Vitality therefore is not restored by conjugation under the conditions of the experiments; whether it is due to these conditions, due to the pædogamic nature, or due to some other cause remains to be shown.

It is expected that this paper will be published in full in the *Journal of Morphology*.

Actinobolus radians St. and its Cultivation: GARY N. CALKINS, Columbia University.

Regeneration in Paramecium caudatum: FLORENCE PEEBLES, Bryn Mawr College.

The results of a series of experiments on *Paramecium caudatum* show that the power of regeneration varies greatly in different races, and also in individuals of the same race. It usually depends on the condition of the protoplasm, or the age of the individual at the time of the operation. The removal of the anterior one third causes greater disturbance in the cell than the removal of the posterior end. The fragment which is removed always dies, but the larger nucleated piece either regenerates the lost end or divides without regeneration into a normal and an abnormal individual. Regeneration of the anterior end took place in forty per cent. of the cells, while the posterior end regenerated in sixty-three per cent. Cells in the vegetative condition when cut in half form no abnormal individuals. One half dies and the other produces a normal race. It was found impossible by removal of the protoplasm to produce a small race from a large one. After several generations the normal size was restored. Vegetative cells seem to have much division energy stored up within them. Experiments indicate that three division planes are present, so that one cell represents four individuals. The removal of a part of the protoplasm acts as a stimulus, and several divisions follow in quick succession. It was found impossible to cut the macronucleus in vegetative cells so that each fragment contained a part of it. When cells were cut in half during division both pieces received a fragment of the nucleus and formed normal races.

It is expected that this paper will be published in full in the *Biological Bulletin*.

Observations on Synapsis and Reduction: EDMUND B. WILSON, Columbia University.

The maturation-phenomena in *Tomopteris* and *Batracoseps* have been reexamined by a study of the original preparations of the Schreiners and of Janssens, as well as of new preparations of *Batracoseps* fixed and stained by various methods. This study has led to a confirmation of the main conclusions of the above-named observers in regard to synapsis. The seriation of the stages is placed beyond doubt by the conditions seen in *Batracoseps*. In both this form and *Tomopteris* the facts seem to admit of no other interpretation than that the "amphitene" or synaptic stage represents a progressive union of leptotene threads, two by two and side by side (parasynapsis), to form pachytene loops of the haploid number; and in the case of *Batracoseps* there is considerable evidence that this process is accompanied by a close torsion or twisting together of the leptotene threads as they unite. This process proceeds from one pole of the nucleus towards the opposite pole. In the opinion of the author it is impossible to admit the interpretation of this process offered by Fick, Goldschmidt, Hæcker and Meves that it is only a modified form of longitudinal splitting. Observations on the Orthoptera (grasshoppers) indicate that a similar mode of synapsis occurs in these animals, though it is less certainly shown than in the other forms. In the pachytene loops resulting from synapsis all traces of duality are usually lost to view, at least for a time. This may be due either to a close twisting together of the leptotene threads or to an actual process of fusion. In either case there is as yet no satisfactory evidence that the plane of the ensuing "reduction-division" is identical with that of the original conjugation. The facts point on the whole to the conclusion that the period following synapsis is one of reorganization of the chromosomes in which a redistribution of their substance may take place. This may be effected by a process of torsion as the chromo-

somes unite, or subsequently, followed by a new longitudinal split in a new plane, as suggested by Janssens in his theory of the chiasmatype. The conception of the "reduction-division" is however valid, since this division reduces the valence of the bivalent to one half, and it fails to take place in the case of univalent chromosomes, as is proved by the history of the sex-chromosomes, *m*-chromosomes and supernumerary chromosomes in the Hemiptera. The explanation of the Mendelian disjunction may be sought in either maturation-division or in both, as has been shown by Janssens.

The Penetration of the Spermatozoon and the Origin of the Sperm Aster in the Egg of Nereis: FRANK R. LILLIE, University of Chicago.

(1) As described in a previous paper,[1] the egg of *Nereis* secretes a large quantity of jelly, derived from spherules of a cortical layer, immediately after contact of the spermatozoon. The perforatorium of the spermatozoon penetrates the vitelline membrane and becomes inserted in a well-marked entrance cone. *Fixation granules,* undoubtedly derived from the spermatozoon, appear at the tip of the perforatorium in the cone. The substance of the cone becomes differentiated by staining reaction and behavior to form an organ definitely concerned in the subsequent penetration of the spermatozoon. (2) The spermatozoon remains external to the egg embedded in the jelly for 45 to 50 minutes after attachment. The head is then drawn by the cone through the vitelline membrane into the egg in the form of a thick strand of chromatin several times the length of the original head of the spermatozoon. *The middle piece and tail remain external,* and may be seen on the vitelline membrane up to the time of cleavage. They never enter. (3) The chromatic thread representing the head of the spermatozoon then contracts to form a vesicular nucleus, still attached by the perforatorium to the cone. Nucleus and cone then rotate through 180° and the sperm aster arises always at the point of the nucleus farthest from the cone, thus in the position of the base of the sperm head. The problem of the origin of the sperm centrosome in the egg is considered in the next abstract. (4) The "fixation granules" are *possibly* cytoplasmic elements introduced by the spermatozoon, though they come from the apex of the spermatozoon. No other demonstrable cytoplasmic elements are introduced by the spermatozoon. (5) After origin of the aster the sperm nucleus separates from the cone, and the latter gradually disintegrates in the cytoplasm. The sperm amphiaster becomes the cleavage amphiaster.

[1] *Jour. Morph.,* 22, 1911.

On the Fertilizing Power of Portions of the Spermatozoon: FRANK R. LILLIE.

If unsegmented eggs of *Nereis* be centrifuged about 60 revolutions of the hematocrit of the Bausch and Lomb hand centrifuge in about 40 seconds, thirty to forty minutes after insemination, the mass of eggs accumulates at the distal end of the tubes and becomes pressed together. The jelly, which is of less specific gravity than the eggs, then separates from the latter and forms a layer above the eggs. In squeezing through the narrow interstices between the closely packed eggs it rubs over the surface of each egg, and in many cases it carries the attached spermatozoon away with it. In other cases, especially if the eggs are centrifuged shortly before the time of penetration of the spermatozoon, it draws out the substance of the head of the spermatozoon, which is very ductile at this time, into a strand; and in numerous cases it carries away the tail and middle piece, or variable portions of the head in addition. Partial sperm-heads of all sizes are therefore left attached to the egg by the perforatorium. Such partial sperm-heads then penetrate, being drawn in by the entrance cone as in the case of normal fertilization, and they form partial sperm-nuclei attached to the entrance cone within the egg. Rotation then takes place and an aster invariably arises in connection with the partial sperm-nucleus at the point most distant from the cone, *i. e.,* at the most basal point of the sperm-nucleus. By using large quantities of eggs and by preserving at various stages one can study all stages of these processes in sections, and the above statements are based upon large numbers of observations. It is therefore proved (1) that the sperm centrosome is inessential for formation of the sperm aster within the egg; (2) the origin of the sperm aster is a nucleo-cytoplasmic reaction; (3) the sperm-nucleus is polarized with reference to this reaction inasmuch as the sperm aster arises always at the most basal point of the partial sperm-nucleus, with reference to the orientation of the nucleus in the sperm head. The conclusion therefore involves the conception of a certain differentiation between egg-nucleus and sperm-nucleus, for the former has no independent capacity of initiating karyokinetic phenomena, whereas the latter has.

The two preceding papers will be published in full in the *Journal of Experimental Zoology.*

Human Spermatogenesis: T. H. MONTGOMERY, JR., University of Pennsylvania.

The point was made that in man there are four types of probable functional spermatozoa, differing in their content of modified chromosomes. One type has two of these bodies, one has none, one has the larger body only and the other has the smaller only. All primary spermatocytes contain each one larger and one smaller modified chromosome. Further, during the histogenesis of the sperm the cuff of the spermatid is produced from nuclear sap, not from the cytoplasm, and since this cuff substance is thrown away with the abstricted cytoplasm the spermatid loses the greater amount of its nuclear sap. Therefore, this nuclear sap substance can not have the same value in inheritance as the other substances of the nucleus.

To be published in full in the *Journal of the Academy of Natural Sciences of Philadelphia, Centenary Volume.*

The X-element in Guinea-chicken Hybrids: MICHAEL F. GUYER, University of Wisconsin.

The hybrids in question, all male, were the offspring of a black langshan cock and a common guinea hen. The *X*-element of the chicken is very large, of stout build and typically of different shape from that of the guinea. While each usually appears as a curved body, the *X*-element of the chicken is U- or bean-shaped with both ends of the same size, while that of the guinea is more comma- or pistol-shaped, with one end noticeably narrower than the other. The *X*-element of the hybrid was found to be invariably of the maternal (guinea) species type. In this fact may lie a simple explanation of why these hybrids were all male. For in all known cases it is the spermatozoon *without* the large *X*-element which unites with the egg in the production of the new male, and since such a spermatozoon is much smaller than one of the other type, this mere difference in size may be the factor determining which shall fertilize the egg. Hybrids are obtained with difficulty even under the most favorable conditions and we may reasonably suppose that the egg-plasm is more or less resistant or antagonistic to the entrance of a foreign sperm. If such is the case it would seem not improbable that the smaller type of spermatozoon with its diminished quantity of incompatible substance and its lessened surface against which resistance could operate, would penetrate more readily than the other, with the consequent production of a male.

To appear in full in *Journal of Morphology.*

Eight Factors that Show Sex-linked Inheritance in Drosophila: T. H. MORGAN, Columbia University.

Eight factors that show sex-linked inheritance have appeared in cultures of the fruit fly, *Drosophila.* These factors without exception follow in their heredity the distribution of the sex-chromosomes with which they may be said to be linked. (1) The red eye of the wild fly is due to three factors—vermilion *V,* pink *P* and orange *O.* Of these *V* is not sex-linked, while *P* and *O* follow the sex-chromosomes. The red eye may be designated by *VPO,* the pink eye by *vPO,* the vermilion eye by *VpO* and the orange eye by *vpO.* Orange is present in all these cases, but since like *P* it is sex-linked (see below), it occurs in duplex in all females and in simplex in all males. The heredity of these eye colors has recently been published.[2] (2) A new color has more recently appeared, due to the loss of the orange factor. The formula for this mutant seems to be *VPo.* The females have darker eyes than the males; thus giving a dimorphic race. The *O* factor proves to be sex-linked. It will now be possible, unless associative inheritance interferes, to produce a new series of reds, vermilions and pinks that lack orange; and an eye that lacks all color determiners, but contains the color producer *C.* (3) White-eyed mutants due to the loss of the color producer *C* have been described,[3] and these may carry the determiners for vermilion, pink or orange, etc. (4) The gray color of the wings of the wild fly is due to three factors—black *B,* yellow *Y* and brown *Br.* The formula for the wild fly is *BYBr;* for the black fly *ByBr;* for the yellow fly *bYBr,* and for the brown fly *byBr.* Of these three factors black, *B,* is sex-limited; yellow, *Y,* is not; and *Br* has not yet dropped out, so that its distribution is unknown. (5 and 6) Two wing mutants, described as rudimentary wings and miniature wings, both show sex-linked inheritance.[4] The miniature wing is due to the loss of a factor *S;* its formula is *Ms.* The rudimentary or "short" wing is *Sm.* When a miniature female is crossed with a short male, all the females (*Ms Sm*) have long wings; all the males (*Ms..*) have miniature wings. When the "short" female is crossed to the wild male all the females (*Sm SM*) have long wings, and the few males that appear have short wings. The females are to the

[2] *Jour. Exp. Zool.,* 1911.

[3] SCIENCE, 1910.

[4] SCIENCE, 1911.

males as three hundred and eighty-one to three (381:3). (7) The bands on the abdomen, so conspicuous a feature of the normal fly, have been lost in another mutant. The factor is dominant and sex-linked.[5] (8) Another wing mutant has appeared in which the second inner vein fails to reach the margin, often producing a bifid wing, but the shape of the wing is varied. The wings are held out at right angles to the sides of the body. The factor responsible for this condition is also sex-linked. Thus bifid-winged females crossed with wild males give all normal-winged females and bifid-winged males. The reciprocal cross gives normal-winged males and females. These inbred give normal-winged females and males and bifid-winged males.

Supernumerary Chromosomes and Conjugation of Chromosomes in Ceuthophilus (Sp.?): N. M. STEVENS, Bryn Mawr College.

The usual number of chromosomes in the spermatocytes of the first order is 19, eighteen bivalents and the univalent *X* chromosome. In one individual two supernumeraries, and in another one were found. These supernumerary chromosomes behave like those in *Diabrotica soror* and *D. 12-punctata,* dividing sometimes in the first, sometimes in the second maturation mitosis; and they probably originate, as in the *Diabroticas,* in an abnormal division of the *X* chromosome. In *Ceuthophilus* synapsis or conjugation of the chromosomes takes the form of parasynapsis. The chromatin threads pair side by side, twist together and in the prophase untwist. The homologous members of each pair unite end to end, forming compound rods, crosses or E-shaped figures, or they may unite by both ends, forming rings. The first maturation mitosis is a segregation division, the second equational. There is no synizesis stage, and no marked polarization of the chromosomes to form a bouquet stage.

This paper will be published in full in the *Biological Bulletin.*

Chromosome Studies: F. PAYNE, Indiana University.

A continued study of the Reduviidæ throws no further light upon the origin of the irregular chromosome distribution found in that family. In *Pnirontis,* however, is found a type of distribution new to the family and similar to that of *Gelastocoris oculatus.* In *Pselliodes,* which gives another type similar to that of *Prionidus* and *Sinea,* the single chromosome, the homologue of the small idiochromosome, contains a larger quantity of chromatin than the three small chromosomes which go to the opposite pole. In this respect it is similar to the case of *Acholla.* A study of the ovaries of *Gelastocoris* reveals a nucleolus which forms shortly after the last oogonial division and remains until about the time of synapsis. In most cases this nucleolus stains uniformly, but in favorable places darker bodies can be seen within it. It seems probable that these darker bodies are the idiochromosomes, eight in number. In these ovaries the ova can be traced with unbroken continuity from the end chamber to the fully developed eggs.

To be published in full either in the *Journal of Morphology* or in the *Biological Bulletin.*

The Histogenesis of the So-called Apyrene Spermatozoa in Strombus: EDWIN E. REINKE, Princeton University.

The apyrene spermatozoon of *Strombus,* as compared with the eupyrene or ordinary spermatozoon, of this species, is a very large cell with a complex structure. The cell-body is cylindrical and tapering in shape and it is filled with many polygonal bodies which are undoubtedly composed of albumen. These bodies are very regular in outline and are arranged in rows; they vary considerably in size, those in the middle of the cell being larger than those at either end. The breadth of the cell is greatly increased by the presence of two undulating membranes which pass down either side of the cell and meet at the posterior end, where they are drawn out into a long sharply pointed tail-piece. Anteriorly these membranes fuse in the mid-line and give a broad, rounded appearance to this end of the cell. At the very tip, where the membranes meet, there is a darkly-staining cap; this is a centrosomal structure. Lying scattered through the cell and between some of the albuminous bodies are fragments of greatly degenerated nuclear material. The entire length of the spermatozoon is about 90 micra. The apyrene spermatozoa are found to originate from certain large pear-shaped cells which are attached by their narrow ends to the cyst-wall of the testis. These cells are easily recognized and can readily be distinguished from the eupyrene spermatocytes, not only by their size, but also by the presence of a large sphere with strong astral rays. The development of the apyrene spermatozoa from these cells is direct, that is, no cell-division occurs during their histogenesis; the nucleus simply breaks down, scattering nuclear fragments throughout the cell. These fragments immediately begin to degen-

[5] *Proc. Soc. Exp. Biol. and Med.,* 1911.

erate and play no further active part in either the developing or the adult spermatozoon. At the time of the breaking down of the nucleus, the large sphere with its astral system disappears, leaving only the contained centrioles and a mitochondrial mass which surrounded it. There are a great many of these centrioles and, lying close together at the periphery of the cell, they very soon divide and one half of the resulting granules begin to move across the cell. In this way a large bundle of very thick axial fibers is formed and its subsequent growth greatly increases the length of the cell. Before it has reached its full growth, however, the bundle splits down its long axis. Continued growth causes each half of the bundle to pass to opposite sides of the cell. Here, by fusing and pushing out the cell wall, they eventually form the undulating membranes. The albuminous bodies first appear a short time before the bundle of axial fibers begins to split. They are formed by the filling up with albumen of previously existing vacuoles. At first these bodies are spherical, but later, through crowding, they become polygonal. The foregoing facts, relative to the development and the adult structure of these cells, would indicate that their function, if any exists, must be widely different from that of the ordinary spermatozoa. Indeed, the evidence at hand is almost strong enough to make the application here of the word spermatozoon, in its specialized meaning, a misnomer.

Reinvigoration Produced by Cross Fertilization in Hydatina senta: David D. Whitney, Wesleyan University.

A report of experiments was given in which Dr. Whitney has reared rotifers for five hundred generations by the parthenogenetic method. The females of each generation laid eggs and these at once without fertilization by a male grew into females for the succeeding generation. Dr. Whitney observed two long experiments for about three years and found that these animals gradually became weaker and weaker by this maleless method of reproduction and finally died out from general weakness if the experiments were carried on long enough. One of the races lived for 385 generations and the other is still alive in the 503d generation, but is in a very weak condition. When both races were alive and had reached a weakened condition males were produced from them and some inbreeding experiments were made in which eggs were fertilized by the sperm of the males of the same race. This was done in order to determine whether fertilization would bring the race back to normal vigor. Several successive inbreeding experiments were made and only resulted in a slight amount of reinvigoration of either race. However, when the two weak races were crossbred a great amount of reinvigoration occurred at once and the resulting race was as vigorous as any young normal race.

To be published in full in the *Journal of Experimental Zoology.*

External Agents and the Growth Period of the Egg in Hydatina senta: A. F. Shull, University of Michigan.

It is not possible to reduce the proportion of male-producers in this species of rotifer by transferring to manure solution eggs that have been laid in spring water, even though the manure solution is strong enough to exclude male-producers when the rotifers are bred continuously in it. The nature of the females is determined, therefore, before they hatch. A female that has already produced some male-producers, ceases almost immediately to yield male-producers if she is placed in manure solution. A female that has produced part of her family (all female-producers) in manure solution, may commence to bring forth male-producers almost immediately if she is transferred to spring water. The kind of female which will hatch from an egg is determined, therefore, within a period of two or three hours before the egg is laid. This period includes the entire growth of the egg and the formation of the single polar spindle.

The complete paper will appear in the *Journal of Experimental Zoology.*

Notes on the Inheritance of Barring: H. D. Goodale, Station for Experimental Evolution.

Some Reactions of Drosophila to Parallel Rays of Light: H. G. Kribs, University of Pennsylvania.

The *Drosophila* were placed in a tube 8 inches long and about 1⅛ inches in diameter. When placed in the light with the axis of the tube parallel with the rays no characteristic reaction could be observed. When the axis of the tube was tilted to an angle of about 45 degrees to that of the rays the flies at once showed their characteristic orientation. When, however, the ommatidia forming the central mass of the eye were painted over, the flies no longer reacted in the normal way when the axis of the tube was placed at the 45-degree angle, but would do so when it was placed parallel to the rays of light.

The following communication from a member of the society was received by the secretary too late for presentation at the Princeton meeting:

A Peculiar Structure in the Embryo of the Honey Bee: JAS. A. NELSON, U. S. Department of Agriculture.

In embryos from fertilized eggs of the honey bee, at the time when the germ layers are forming, but before the lateral folds have begun to unite, a small lenticular mass appears on the dorsal side of the egg, close to the cephalic pole. Its outer surface is almost plane, its inner strongly convex and studded with numerous delicate processes which join with the protoplasmic meshwork of the interior of the egg. This mass, which will be termed provisionally the cephalo-dorsal disk, appears to be a syncitium, composed of rather clear and vacuolated cytoplasm, within the inner half of which numerous nuclei are embedded. It lies at the surface of the egg and is continuous at its edges with the surrounding blastoderm. This structure was first noticed in 1904 by O. Dickel, who called it the "yolk plug." Dickel identified the point in the blastoderm where it first appeared as the blastopore, described the disk as formed by the migration of yolk cells to this point, and sought to connect it with the rudiments of the mesenteron, in an endeavor to interpret the process as gastrulation. A study of the antero-dorsal disk in sections of eggs of various ages shows: (1) that the so-called yolk plug does not arise from yolk cells, but from the blastoderm of the dorsal side of the egg by a cephalad migration of its cells and their aggregation at this point; (2) that at no time has the cephalo-dorsal disk any connection with the rudiments of the mid-intestine; (3) that during the stages immediately following the formation of the germ layers it becomes broken up into amœboid cells which wander off into the yolk at the cephalic end of the embryo. It therefore appears to be a center of distribution for cells from the blastoderm to the yolk. Its homologies are obscure, although Hirschler (1908) has described a somewhat similar structure which he called the "dorsal organ," in the egg of the chrysomelid beetle *Donacia*. It is also interesting to note that the cephalo-dorsal disk has, in its position, time of appearance and structure a very close resemblance to the cell mass described by Petrunkewitsch in the drone egg as derived from the polar bodies and later forming the male sex cells.

The following exhibits were made during the meeting of the society:

An Early Human Cranium: H. H. WILDER, Smith College.

Microscopical Preparations of Epithelium of Plathelminths: R. T. YOUNG, University of North Dakota.

Microscopical Preparations to Show Amitosis in the Testis of Tœnia serrata: R. T. YOUNG, University of North Dakota.

JOHN H. GEROULD,
Secretary

DARTMOUTH COLLEGE

THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

THE fourth annual meeting of the American Institute of Chemical Engineers was held in Washington, D. C., December 20–23.

The reports of the various officers for the year were read, and a very gratifying growth in membership was shown. New officers for the year were elected as follows:

President—Dr. L. H. Baekeland. *Second Vice-president*—Dr. T. B. Wagner. *Third Vice-president*—Professor M. C. Whitaker; the first vice-president being Dr. Eugene Haanel. *Treasurer*—Dr. F. W. Frerichs. *Secretary*—Dr. John C. Olsen. *Auditor*—Mr. G. W. Thompson. *Directors*—Messrs. A. C. Langmuir, H. S. Miner and A. Bement.

The following papers were read at the Wednesday morning session:

"The Hardening of Plasters and Cements and a Simple Chronographic Apparatus for Recording Set," Dr. Chas. F. McKenna. A very ingenious as well as simple instrument for measuring and recording this important property of cements was shown and explained by Dr. McKenna.

"Advances in Testing Explosives," Clarence Hall.

"Distribution of Power in Portland Cement Manufacture," Richard K. Meade.

"Problems in the Manufacture of C.P. Acids," J. T. Baker.

"Combustion of Pulverized Coal," L. S. Hughes.

"Manufacture of Gelatin," Ludwig Thiele.

During the afternoon the institute visited the Bureau of Standards and inspected the standardization of weights and measures, adjustment of pyrometers, thermometers, pressure gauges and similar instruments, as well as the liquid air apparatus. Every one was impressed by the very excellent work being done by this important government bureau.